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MILLING PRODUCTION SECTION

Temperature Measurements In the Reduction System

By J. Flechsig

Federal Research Institute for Cereal Products
Detmold, Germany

EDITOR'S NOTE: The following article was abstracted from a paper read at a recent milling convention in Germany.

Heating in the reduction process has an influence on:

1. The results of milling.
2. The power consumption.
3. In all probability, the baking properties of flour.

The results of experiments in the author's laboratory indicate that a rise in temperature of products during milling increases the proportion of coarse granulations in the products. This opinion is shared by various other European investigators. Many American millers are of a different opinion; they feel that the proportion of fines increases with mounting milling temperatures.

Table I—Heating as a Function of Roll Setting

Passage	Gap temperature °C.	Temperature increase °C.
1st Break	29.0	3.0
2nd Break	26.0	2.0
1st Middlings ...	27.8	5.2
3rd Middlings ...	32.0	7.8
Last Tailings	45.0	15.5

No agreement between these two camps was found. Also, different millers on the European continent differ in their estimates of the influence of heat on baking qualities, the merits of cooling rolls, controlling the temperature of the aspirating air, etc. These divergences are likely to be caused by considerable differences in opinion about what temperatures actually occur between the grinding rolls. Therefore the Cereal Institute set up a test program to establish more basic information on temperatures encountered in milling. The tests were conducted in three commercial plants: a semi-automatic 60-bbl. mill, a combined rye-wheat mill of 250-bbl. capacity and a 1,200-bbl. wheat mill. The tests extended over a full year, and all kinds of atmospheric conditions are included.

General Course of Temperature Changes

Fig. 2 shows the course of temperature and humidity as a product passes through a pair of rolls. The temperature reaches a maximum in the grinding gap. Immediately after leaving the rolls, temperature and humidity recede because of heat transfer to air and evaporation. Temperature and humidity curves level off about 10 cm. (4 in.) after the grinding gap. For example: The thermocouple in the grinding gap of a pair of idling rolls indicated 20° C. About 15 sec. after engaging the rolls, the temperature rose to a constant value of 25° C., while the temperature of the outgoing product was 21.5° C. The horizontal coordinate, calibrated in distance and time values, indicates that the temperature and humidity variations occur in fractions of seconds.

Table II—Influence of Temperature of Incoming Product

Passage	Original product Tz, °C.	Grinding gap Tm, °C.	Tm-Tz	Temperature rise of product, °C.
4th Break	21.0	28.0	7.0	4.0
4th Break	26.8	34.0	7.2	4.9
1st Sizings	13.7	20.3	6.6	4.4
Last Tailings	9.5	31.5	22.0	13.7
Last Tailings	22.0	44.0	22.0	15.0

Table III—Effect of Corrugations

Corrugations (1st Middlings)	Tm-Tz °C.	Temperature rise of product °C.
Sharp to Sharp ..	10.3	5.2
Dull to Dull	16.8	6.8

Conditions Affecting Temperature in the Grinding Gap

a. Setting of rolls—Different passages requiring differently close settings illustrate the well-known fact that heating increases with closer settings. The product temperatures are also influenced by roll settings. (See Table I.)

b. Original temperature of product—The temperature increase of the product is greater for more elevated temperatures, even where Tm-Tz is constant. (See Table II.)

c. Ambient air temperature—The air in the plant affects milling temperatures in two ways: by influencing the original temperature of grain and intermediate products and by a direct heating or cooling effect.

(Continued on page 17a)

Table IV—Gap Temperatures and Temperature Rise of Product

Passage	Difference between gap and air temperature, °C. Average	Range	Temperature rise of product, °C. Average	Range
Breaks—				
1st Break	8.7	6.2-11.5	3.8	2.5- 5.2
2nd Break	8.4	6.0-10.0	2.7	2.0- 4.3
3rd Break	8.7	4.9-12.0	4.8	2.5- 7.0
4th Break	10.1	6.0-14.5	5.4	4.2- 6.5
Low Grade	14.7	13.0-16.7	6.7	5.3- 8.1
Middlings Reductions—				
Head rolls	7.8	3.1-16.0	4.8	0.1-11.0
Center Rolls	14.5	2.4-23.5	7.4	2.2-13.6
Tail Rolls	20.0	9.2-28.0	10.0	2.2-15.5

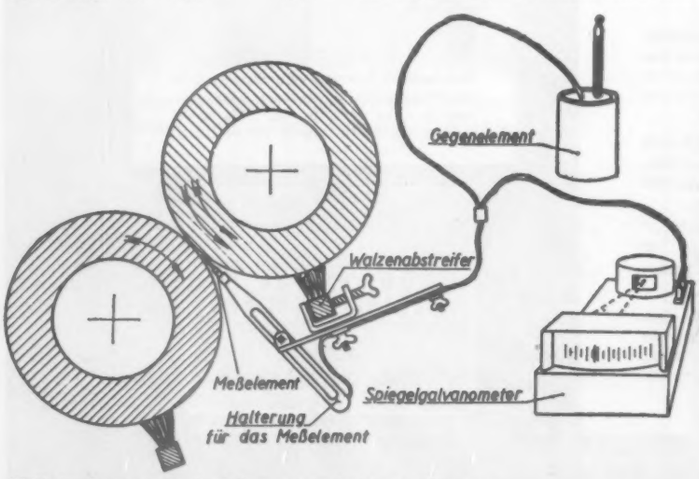

FIG. 1—Arrangement of thermocouple in grinding gap.

Messelement: Thermocouple
Gegenelement: Reference junction
Spiegelgalvanometer: Reflecting galvanometer
Walzenabstreifer: Roll brush
Halterung fuer das Messelement: Thermocouple support

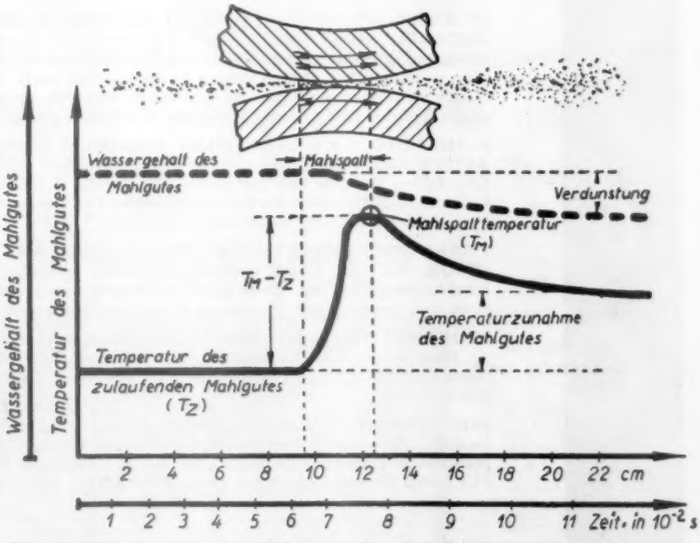

FIG. 2—Temperature rise and evaporation of products passing through grinding gap.

Wassergehalt des Mahlgutes: Humidity of product
Temperatur des Mahlgutes: Temperature of product
Verdunstung: Evaporation
Mahlspalt: Grinding gap
Temperaturzunahme des Mahlgutes: Temperature rise of product
Temperatur des zulaufenden Mahlgutes: Original temperature of product
Zeit: Time

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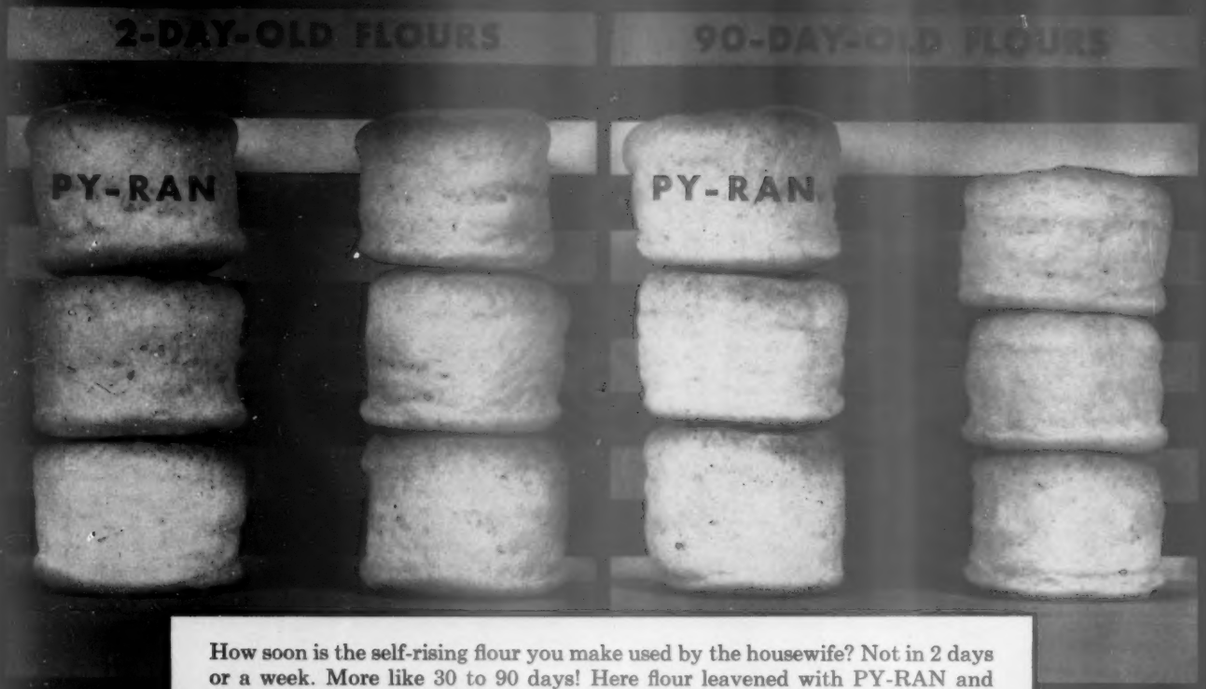

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A Review of Known Information About the Khapra Beetle

EDITOR'S NOTE: The accompanying article is the text of a statement by Dr. R. T. Cotton at a hearing in December on the possibility of establishing a federal khapra beetle quarantine, which has since been ordered. The article contains detailed information on the khapra beetle and its control. This stored grain pest has been found in the U.S. in sections of California, Arizona and New Mexico. Dr. Cotton is with the stored-product insects section, Marketing Research Division, Agricultural Marketing Service, U.S. Department of Agriculture.

The khapra beetle Trogoderma granarium was described by Everts in 1898. It is said to be the worst pest of stored grain in India. It is native to India, Ceylon and Malaya, but has been introduced and become established in Europe, Africa, Asia and Australia including England, Holland, Germany, France, U.S.S.R., China, Japan, Korea, Philippine Islands, Madagascar, Syria, Egypt, Iraq and Nigeria. And now the U.S. has been added to the list.

Biology and Habits

Information regarding the biology and habits of the Khapra beetle has been well summarized by Hinton (1945). He reviewed the earlier research work of Barnes and Grove (1916), Husain and Bhasin (1921), Voelkel (1924), Mason (1924), Taylor (1924), Nakayama (1931) and others. More recent information can be found in publications by Pruthi and Singh (1950), Freeman (1951) and Howe (1952).

The most noticeable features of an infestation by the khapra beetle are the larvae and cast skins as they appear in countless numbers on the surface of bulk grain. The larvae are yellowish brown and clothed with long brown hairs. The integument between the segments, and the underside of the body is pale yellow in color. Viewed from above the yellowish brown segments and paler skin separating them give the larvae a ringed appearance. The young larva is about 1.8 mm. in length. As it matures it increases in length to between 3.0 to 4.0 mm.

The adult is a small beetle 1.8 to 3.0 mm. in length, pale red-brown to dark brown or black in color, with wing covers uni-colorous or with indistinct red-brown markings. It is hairy on top, but often the hairs are rubbed off so that it has a slick appearance. Its small size and immaculate or only vaguely maculate elytra will serve to distinguish it from other species of the group. The males may be distinguished from those of other species of the group by having a dense fringe of moderately stout sub-erect hairs near and more or less parallel to the apical margin of the fifth abdominal sternite.

It is likely to be confused by the layman with the so-called larger cabinet beetle; Trogoderma versicolor (Creutz). This insect is found in similar situations in this country, but usually occurs only in small numbers in contrast with the large populations of the Khapra beetle. The larger cabinet beetle adults are considerably larger, 2.0 to 5.0 mm. in length. Their ground color is black mottled with reddish brown, covered with gray and light-brown scale-like hairs forming a distinct pattern on the wing covers. The larvae closely resemble those of the Khapra beetle and can be distinguished from them only by an expert.

Khapra Beetle Larvae

Feeding habits: Most observers agree that only the larvae feed; however, Barnes and Grove (1916) state that they have seen adults gnawing on eroded wheat grains. According to Pruthi and Singh (1950) the larva is a major pest of wheat, but also attacks oats, rice and maize. Hinton (1945) states that the Khapra beetle prefers grain and cereal products to substances of animal origin, but will

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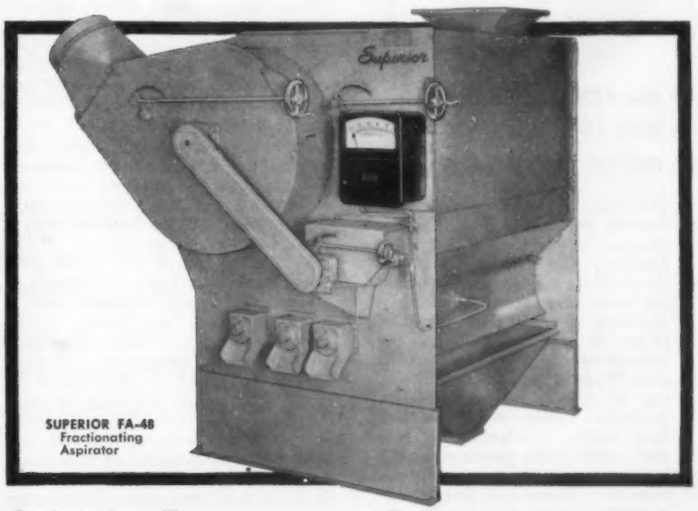

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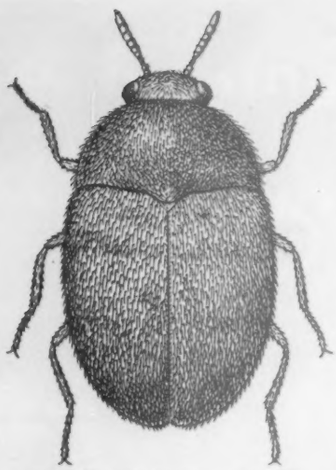

Enlarged Adult Khapra Beetle

develop on dead mice, dried blood, dried insects, etc. It will thrive on wheat, barley, oats, rye, maize, rice, etc., and such cereal products as flour, malt and noodles. Munro (1940) records it in linseed exported from India. Howe (1952) records an enormous outburst of Khapra beetle in groundnuts in Nigeria. In the U.S. it has been found infesting flax seed, alfalfa seed, tomato seed, seed peas, pinto beans, black eyed cowpeas, sorghum seed, grain straw, alfalfa hay and many other products. There is probably little in the way of dried vegetable and animal products that it will not attack.

Life history: According to Freeman (1951) the adults seldom live more than 10 to 12 days. However, Voelkel (1924) observed that the length of the adult life depended upon the temperature. He found it to vary from 8 to 10 days at 39.5° C. (103.1° F.) to 92 to 147 at 10° C. (50° F.). The female adults lay an average of about 50 eggs each, although Voelkel (1924) observed one female to lay a maximum of 126 eggs. The eggs are laid loosely among the food stuff that is infested. The eggs hatch in from 5 to 16 days according to various observers. Larval life is dependent upon the temperature and the food supply. At optimum conditions the larval stage may be completed in 26 days or less, whereas starving larvae may live for years without pubation. The pupal stage may last from 2 to 23 days, depending upon the temperature.

Some interesting data are available regarding the length of the life cycle at different temperatures and in different countries. According to Voelkel (1924) the complete life cycle may vary in length from 35 days at 34.3° C. (93.7° F.) to 147 at 10° C (50° F.). Barnes and Grove (1916) noted that in India the life cycle during June and July was 25 days for males and 33 days for females whereas during July and August the life cycle was completed in 30 days for males and 40 for females. Morison (1925) observed that in Britain the life cycle under favorable conditions was about 50 days and extended to 200 days under unfavorable conditions. In Japan, Nakayama (1932) found that the larval stage was completed in from 317 to 351 days.

In California Lindgren, Vincent and Krohne (1954) conducted experiments at constant temperatures of 90°, 80° and 70° F. At 90° the life cycle was completed in 30 days, at 80° in 64 days, but at 70° the larvae had not transformed after 90 days. The number of generations a year vary from one in Japan to as many as 12 in some parts of India. Optimum temperatures for the development of the Khapra beetle are given by Freeman (1951) as between 90° F. and 95° F. with an upper limit of 104° F. Voelkel (1924) did not find them living at temperatures above 44.2° C. (111.5° F.) Mason (1924) states that the beetle thrives in maltings at a temperature of 132.8° F.; however Husain and Bhasin (1921) found that at 50° C. (122° F.) all stages died in five hours. Voelkel (1924) found that the insect ceased to develop in food stuffs very low in moisture. Taylor (1924) states that they will breed in food with a moisture content of less than 2%.

Barnes and Grove (1916) found that the larvae begin their attack on wheat at some weak place in the pericarp. Whole grains are attacked only by 4th instar or older larvae. Young larvae feed on debris or damaged kernels. The larvae usually molt from four to seven times, but may cast their skins many more times under adverse conditions. The larvae have been observed to scarify woodwork probably in their attempts to burrow into it and find harborage.

Control

Experience has shown that the khapra beetle is extremely difficult to control. The larvae are resistant to many residual insecticides. However, the greatest difficulty results from the inaccessibility of the larvae, due to their habit of crowding into spaces in the structure of buildings, bins, etc., so that sprays and dusts are unable to reach them in toxic concentrations.

British investigators have found pyrethrum sprays and dusts more effective than DDT or Gamma BHC. In this country Lindgren, Vincent and Krohne (1954) report that practically no kill was obtained when larvae were exposed for two hours to a surface deposit of 1000 micrograms per square centimeter of DDT, malathion, lindane, aldrin, dieldrin, parathion, chlordane, methoxychlor, DDD and allethrin.

Fumigation with methyl bromide has been found effective. According to Freeman (1951) the larvae show the same resistance to HCN as the rice weevil. Lindgren, Vincent and Krohne (1954) found that several times as much acrylonitrile or methyl bromide was required to kill 95% of the larvae as to kill the rice weevil or granary weevil.

Means of Spread

The khapra beetle has but feeble powers of migration. There is some question regarding its powers of flight. Most investigators maintain that it does not fly, whereas others contend that it does.

Apparently human agencies were responsible for the spread of the pest, from one installation to another in California, Arizona and New Mexico.

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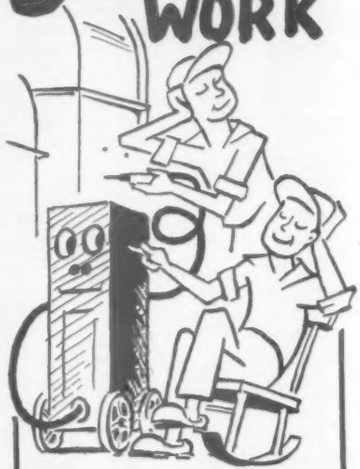

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How to Look for The Khapra Beetle

The U.S. Department of Agriculture recently issued a report detailing things to watch for so that grain handlers can help prevent spread of the khapra beetle.

USDA notes that this insect belongs to the same family as the carpet beetles often found in dwellings. It is usually first noticed because of the presence of its fuzzy larvae, or their cast skins, in clusters around the corners of grain bins, or in used sacks. It is spread from place to place in grain, feed, seed or used sacks. It will probably be found only indoors, in warehouses, storage bins, or mills, or in railway cars or trucks used to transport grain, or similar places.

Like the rice and granary weevils, it can attack sound kernels of grain.

Here is USDA advice on how to look for the khapra beetle:

Hand-sift grain. Look near the edges of a grain pile or next to the wall of grain bins, loaded freight cars, or other storage places. Take a double handful of grain, shake lightly and let grain sift through fingers. If khapra beetles are present, you may find the fuzzy larvae or the cast skins clinging to the skin of your hands.

Screen sweepings. When a freight car, truck or grain bin is emptied, screen a handful of sweepings through window screen and examine for larvae or cast skins.

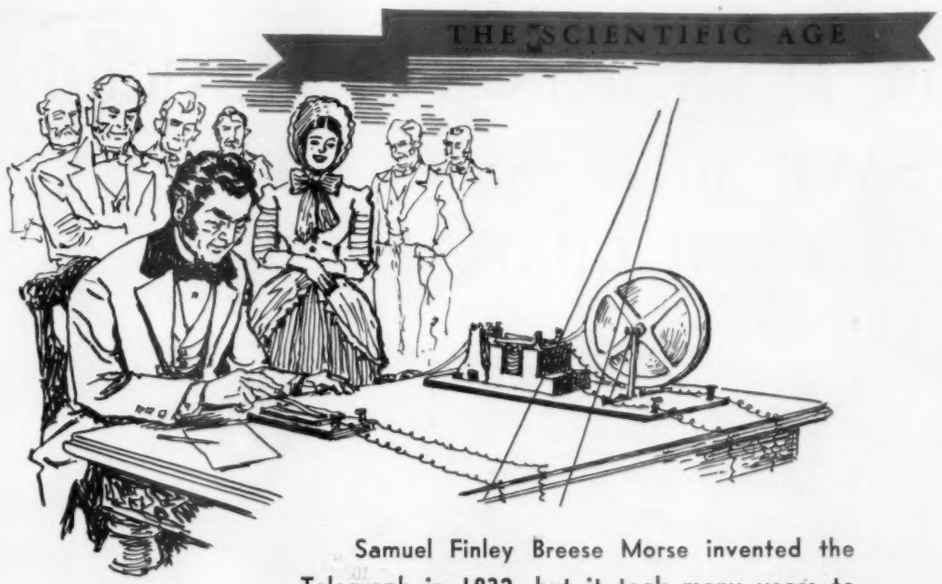
Check bag corners. Examine the outer surfaces of bagged grain, seed or screenings for larvae or cast skins. Pay particular attention to the top seam and the inside of the ears of a bag.

Examine grain bins. Examine corners next to wall studs, footings and similar places in grain bins. The larvae leave the grain when ready to pupate and congregate in great numbers in such locations.

Also, examine cleanings from elevator boots, conveyor systems, vacuum cleaner systems and bag cleaners. Examine screenings from seed or grain samples.

USDA urges that if anyone finds in his grain any fuzzy larvae of the type described, he should capture adult insects found near them, and send both larvae and insects for identification to: Insect Identification and Parasite Introduction Section, ARS, U.S. Department of Agriculture, Beltsville, Md.

Place specimens in rubbing alcohol or 75% grain alcohol if available. Use either a glass or plastic vial that will hold alcohol without leaking. Pack in cotton and place in a small box or mailing tube. The return address should be placed on the package, and you should indicate that you suspect this to be the khapra beetle. Live specimens should not be sent through the mail.



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Wheat Conditioning And Drying

Wheat conditioning is the subject of one of the current projects of the technical research committee of the Association of Operative Millers. In this connection, the committee, at a recent meeting, heard a presentation made by Frank M. Heide, MIAG NorthAmerica, Inc., Minneapolis.

Mr. Heide read a translated report by Dr. H. Gehle, technical manager of MIAG, Braunschweig, Germany. Dr. Gehle noted that letters and reports indicated that the paper he presented at the 1954 AOM technical conference had been of interest to the committee, and he provided more details for the committee on wheat conditioning and drying.

The text of Dr. Gehle's report to the AOM technical committee follows:

I believe that your main interest concerns the conditioning of hard wheat, especially hard winter and northern spring, to obtain the best possible results in the milling process.

(Dr. Gehle then pointed to illustrations showing cuts through the grain kernel at the outer parts of the endosperm, i.e. the parts which join the aleurone layer.)

This section of the endosperm is decisive to the milling behavior of the grain. The separation of endosperm and bran takes place at this layer by the methods of milling now used for the separation of flour and bran.

Moreover, the endosperm itself must be brought to a condition which is best for this separation, it must have a certain mellowness. For the mellowness of the endosperm the well known formula is used:

C = Function of Te, M, Ti
Te = Temperature
M = Moisture
Ti = Time
C = Conditioning effect.

This means that the conditioning or mellowing effect is a function of the three factors: temperature, moisture and time.

If you work without heat, that means keeping the factor temperature very low, the factor time must be high, and the wheat must be kept a long time in the tempering bins, probably for days, to get a really good mellowing effect. Under American conditions it is not possible to make good use of the factor M (moisture) since the moisture content of the flour has to be kept at about 13½ to 14%.

Therefore, the method of conditioning in tempering bins allows only few variations. Because of this, I suggested at Chicago to use the MIAG radiator conditioner with the approved streamline shaped radiators. The factor Te = temperature could be made use of and the factor time could be reduced considerably.

Furthermore, by the use of the radiator conditioner the factor M (moisture) can be changed because in the lower part of the conditioner, part of the moisture used for the conditioning process can be withdrawn. The time needed for the conditioning process will be shorter if a higher moisture content is worked with. For this purpose, the wheat is brought to the conditioner with approximately 2% more moisture as desired at the 1. break. The excess of moisture will be removed by the lower heating compartments and the cooling zone after the conditioning process in the upper part of the conditioner.

It is advisable to temper the wheat after the conditioning process for about six to eight hours prior to bringing the wheat to an atomizing damper—to apply a very fine spray of moisture and thereby toughen the bran—and to the 1. break roll.

The radiator conditioner should have a capacity of about 1½ hours. The radiators should be arranged and formed to guarantee uniform flow of wheat through the entire conditioner. Each heating section of the conditioner is equipped with built-in canals. Every second canal is connected to an exhaust system with means of regulating the exhaust. The exhaust suction has to be set in such a way, that the sweating process will not be impaired throughout the conditioning process even though the excessive moisture — as mentioned above—has to be removed.

Outer Layer Treatment

In situations as in the U.S., where the mellowing of especially dry and hard wheat is desired, the advantage of the radiator conditioner could even be improved by the outer layer treatment.

This new process has been brought about by the realization that at the point where the grain has been attached to the ear—the tip cap—many tiny capillary tubes begin. If dry grain is brought into a vacuum chamber, the air from within the grain will escape at this point and the capillary tubes become exhausted. If thrown into water at this stage, the capillary tubes at the outer layers of the grain will be penetrated rather rapidly, even without the use of higher temperatures. It is reasonable to say that such a treatment will assist the conditioning process in behalf of better mellowing considerably.

This is the case because:

(1) A larger amount of water will

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penetrate the outer layers of the grain much faster than is possible by the usual process of washing and damping.

(2) The heat absorption of the endosperm is activated because the increased moisture content of the grain facilitates this process.

Combination of Machinery

A suitable combination of machinery to obtain the desirable mellowing of the grain would therefore be as follows:

1. A MIAG inflow-separator — to take out all impurities and especially broken or damaged grain which will influence the conditioning effect. The broken grain kernels are spouted to the radiator conditioner directly. The water absorption of the broken grain would be too high since the fractured surface of the endosperm is not protected by the aleurone layer. The heavy and undamaged kernels, coming from the separator go to the

2. Outer layer treatment apparatus. The procedure is as follows: The inlet and outlet of the treatment chamber each has a vacuum seal of special design, a so-called cap seal which functions even with very wet grain. At first the lower seal is closed and the grain enters the treatment chamber through the upper seal. Then the upper seal is closed, too, and the chamber is evacuated by a vacuum pump. As soon as the desired evacuation is obtained, water is injected into the treatment chamber and the vacuum process finished. The water will be sucked in by the above mentioned tiny capillary tubes eagerly. After a few minutes of treatment the lower seal is opened and both grain and water flow out of the chamber. The lower seal closes again and a new process starts. The discharged grain—in a steady stream regulated by an adjusting device—is brought to the

3. Wash machine. The performance of the washer is known. Besides a good washing effect, a good separation of the stones carried along with the wheat is necessary. From the washer, the grain is led to the

4. Radiator conditioner. Here the grain is mixed with the above mentioned broken kernels. In the radiator conditioner, the grain is treated to the desired good mellowness. As I explained already, it is possible to work with excessive moisture in the upper part of the conditioner. In the lower part of the conditioner the moisture is slowly reduced without disturbing the mellowing process. Suitable regulating devices and exhaust flutes are built-in for this purpose. After the prepared wheat with the correct moisture content has passed the cooling zone, it will leave the radiator conditioner well mellowed and suitably conditioned. After a thorough cleaning by a

5. Brush machine with rotary screen the wheat is brought to the grinding bins, well prepared for the further milling process.

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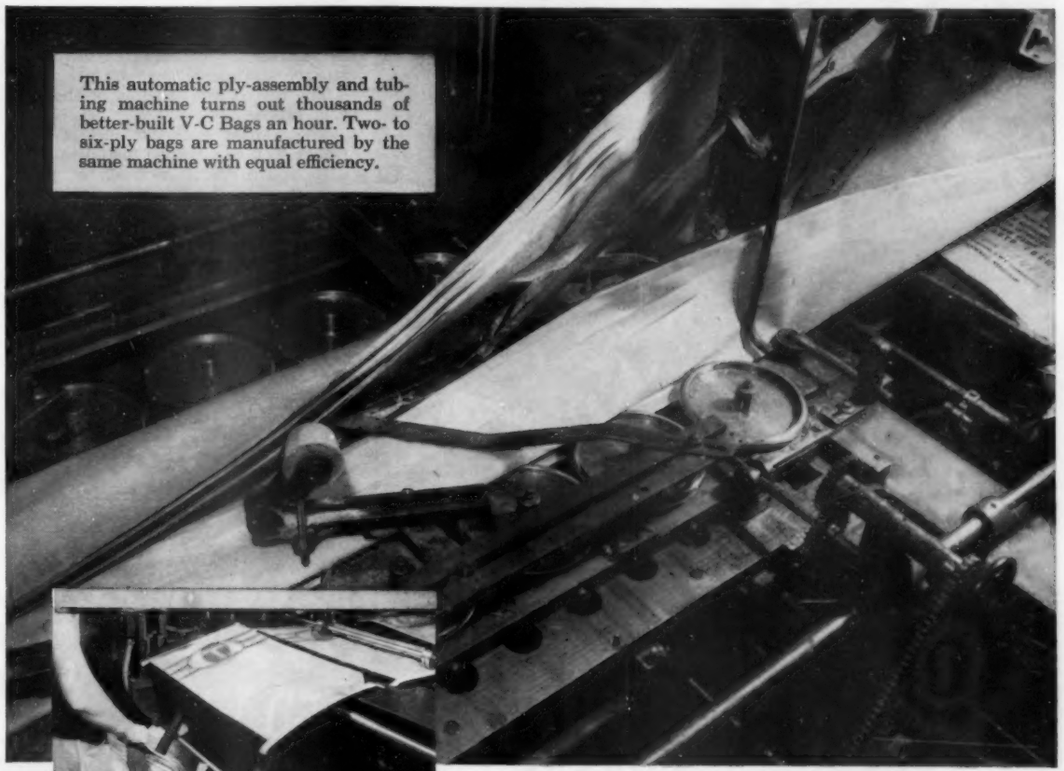

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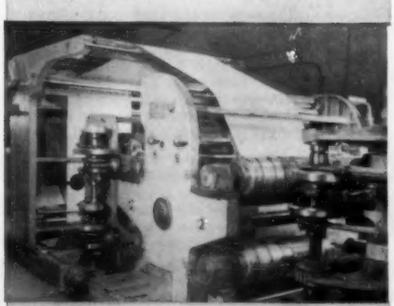

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Research on Wheat Quality as Related to Processing and Utilization

A research plan to improve hard red winter wheat was outlined recently by a committee composed of experiment station workers in the major hard winter wheat states.

The plan shows lines of research needing attention, areas of basic study, requirements for an accelerated program and estimated costs of the research. Up to date information on current and future problems is provided.

One of the sections of the committee's report deals with wheat quality as related to processing, utilization, storage and marketing.

The text of that section of the report follows:

The almost exclusive use of the wheat crop as a human food demands safe and efficient methods of production, marketing, storing, and processing that contribute to high quality and that retain high quality. Hence, studies on maintaining quality and on exploring new levels of quality have equal value in a research program.

In the past, wheat quality investigations have consisted largely of routine services to the plant breeder. Research on the milling and baking quality of new wheat varieties is of the utmost importance to the overall wheat improvement research program, but failure to appreciate what "quality" in wheat really means in terms of marketing, storing, processing and consumer acceptance will result in a short-sighted program.

In the broadest sense, wheat quality considerations must be related to the problems of providing wheat that most nearly meets the requirements of domestic and foreign markets and of studying all ways of enhancing the safe storage of wheat and wheat products. In addition, the accumulation and interpretation of fundamental facts concerning the chemical and physical properties of wheat and wheat products are essential parts of a wheat quality research program. Since wheat is a biological material, it is subject to extreme variability depending upon environmental conditions and/or varietal characteristics. To recognize and to learn to control these variables is of the utmost importance to all concerned with wheat utilization.

A few of the wheat quality con-

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siderations requiring attention are outlined briefly.

Physical, chemical and enzymatic properties of wheat that determine bread-baking quality.—To make continued progress toward a better understanding of the milling and baking properties of wheats and to efficiently evaluate and characterize materials from the breeding programs, it is necessary to have more basic knowledge concerning the chemical, physical and enzymatic properties of the constituents of wheat. Proteins are mainly responsible for many of the quality characteristics of bread flour, but the fundamental nature of proteins is complex. It has been demonstrated that the quality of gluten is the major factor which determines the differences in bread baked from good and poor quality varieties, yet the specific chemical or physical differences between the proteins of good and poor varieties are not known. Information is needed concerning specific characteristics and the proportion of the individual amino acids in wheat proteins and whether the proportions differ in different varieties.

Likewise, little is known about the nonprotein nitrogen and its role or the function of the sulphur-containing amino acids in determining quality of flour for baking purposes. There is also need for an adequate understanding of the oxidation-reduction system in wheat and whether this variable is associated principally with the sulphur-containing amino acids.

Expansion of leaf feeding research should elucidate the effects of nitrogen compounds and of such compounds containnig sulphur and phosphorus on the quantity and quality of protein. The application of radioactive tracer techniques should be explored in this research. Also, more effort needs to be applied to determine the specific effects on protein quality of adverse environmental conditions with the objective of selecting varieties less subject to damage or possibly suggesting methods of handling damaged samples satisfactorily in commerce.

Increased knowledge of the nature and properties of the proteins of wheat and flour can be obtained only by the sustained effort of many research workers with adequate financial support. Likewise, fundamental studies on starch and the other constituents of wheat should be supported.

Physical dough testing. — Much progress has been made relating dough mixing properties to quality in flour for bread-making purposes. Other physical dough testing methods should be studied to determine their usefulness in describing quality characteristics. Several new types of equipment developed in Europe have not been investigated in the U.S. because of the cost of the equipment.

Milling and baking quality of new varieties.—As the program for the development of new wheat varieties is increased, the quality testing programs must also increase proportionately. Micro milling and baking tests must be developed to aid the plant breeder in making selections early in the breeding programs. Once the specific characteristics that determine quality of flour for a specific use are known, micro tests can usually be developed. More information is needed on the genetic factors related to quality.

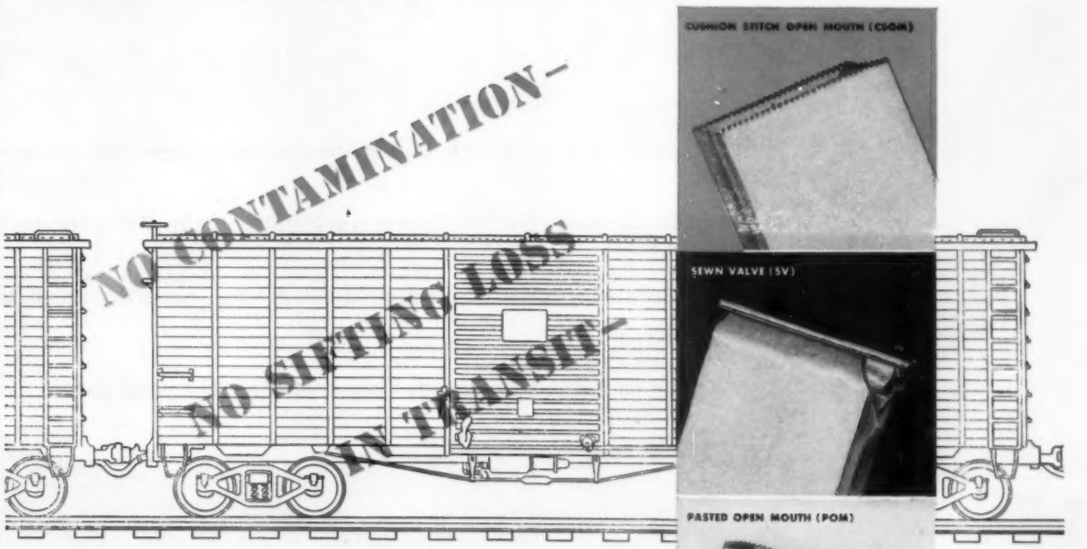
Experimental testing and commercial requirements.—Pilot plant testing of the milling and baking quality of new wheat varieties before release is a necessary step in the wheat improvement program. This helps to assure that new varieties will meet the needs of the grain trade.

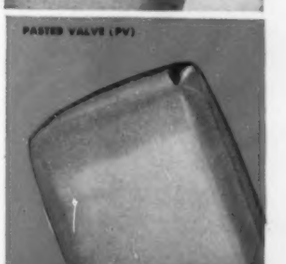
Keeping wheat safe in storage.—Storing wheat at sufficiently high moisture to permit heating and other types of damage such as discoloration, musty odor, loss of viability and increase in fat acidity results in a reduction in the value of the grain for milling purposes. Another serious problem of grain in storage is "sick" wheat. Research is needed to secure information on the conditions responsible for these types of damage, how to control them, and whether there are varietal differences in the tendency to become "sick" or to deteriorate in storage owing to other causes.

Research is needed to find effective means of curbing the growth of microorganisms and subsequent spoilage in stored grain. More research is needed to provide effective control of insects and means for detecting infestation in stored grain.

Grades and market quality.—The characteristics on which market grades are based only partially indicate the true value of the grain. Test weight, for example, only partially determines flour yield for samp'es of a given variety grown under different environments, while it has little relation to flour yield of different varieties. Research should be undertaken to develop tests that accurately reflect the intrinsic characteristics of samples of wheat and that can be applied satisfactorily in the marketing of grain.

Wheat and flour exports.—In the years immediately ahead, the U.S. will continue to need export markets for wheat and wheat products. The quality of our wheat and flour exports must be improved to compete with shipments available from some





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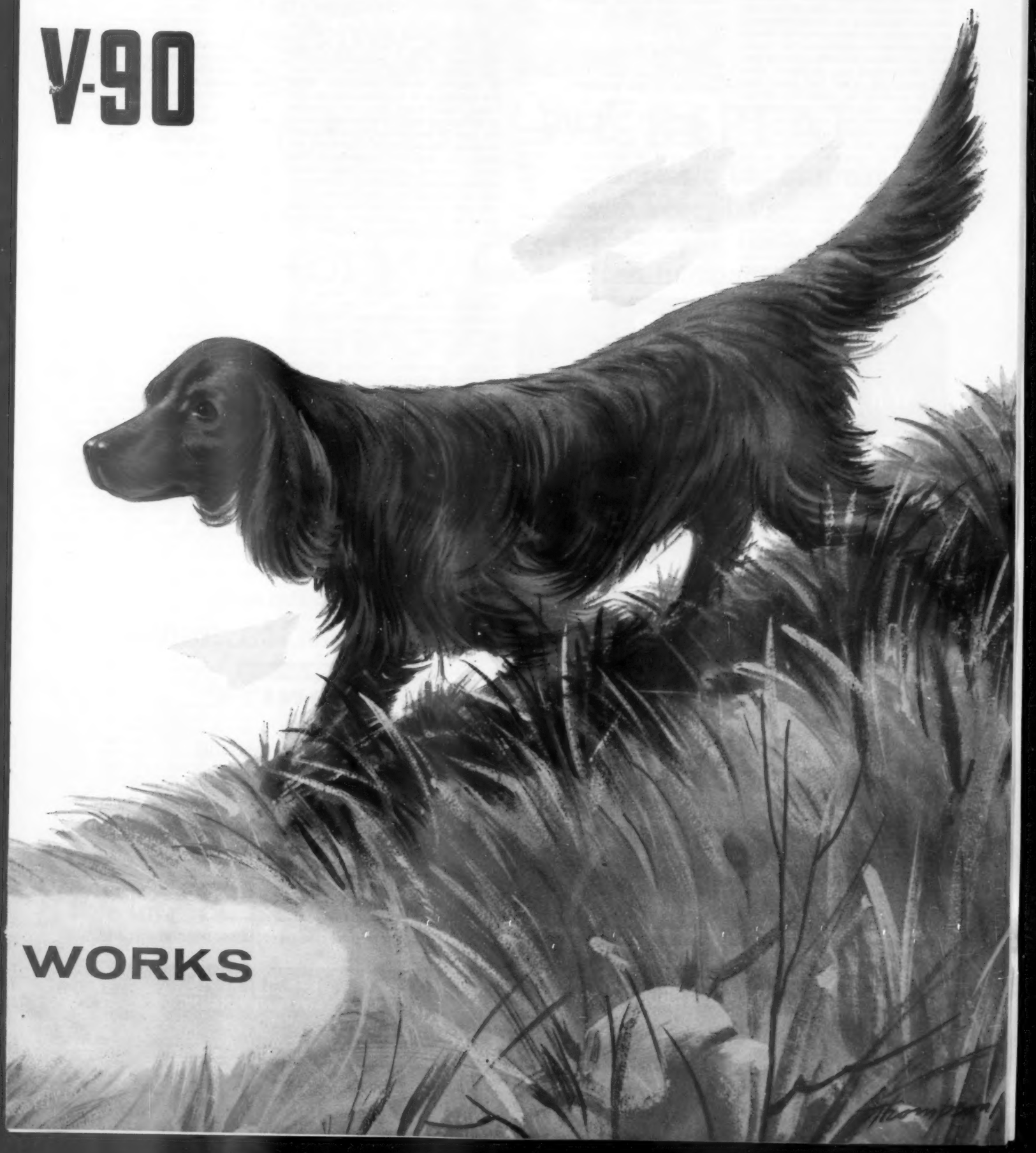

WORKS

other exporting countries. The entire problem of fitting our wheat and flour exports to satisfy export demands and to meet competition requires reconsideration. Also, research should be undertaken to expand the bread eating habits of more of the world's population. The possibility of exporting bread should be studied.

Biochemical and biophysical studies.—Biochemical and biophysical approaches to determine why some wheat varieties have resistance or immunity to disease and insects and to adverse environmental conditions should be pursued. If biochemical distinctions can be found, then the possibility exists that short cuts can be made in the process of screening wheat varieties for adaptation and resistance to infestation and disease. Preliminary studies indicate, for example, that resistance and susceptibility of wheat varieties to the hessian fly may be determined by the relation of enzyme systems to nutrition of the insect larvae. The resistance or susceptibility of wheat to rust must have a biochemical explanation which when discovered might permit the rapid evaluation of rust resistance in the laboratory, thus reducing the present extensive field tests. The effect of field infestation and disease on the quality of wheat for milling and baking is not understood fully. Conditions which adversely affect the wheat plant also must have an important influence on the quality of the grain.

—BREAD IS THE STAFF OF LIFE—

SALES MEETING

CHICAGO—Sales, engineering and administrative staff members of the Prater Pulverizer Co., Chicago, gathered recently for their annual meeting.

Concluding the meeting was an inspection tour of Prater's own production facilities which have recently undergone a 50% expansion.

—BREAD IS THE STAFF OF LIFE—

MISSOURI TRANSACTION

COLUMBIA, MO.—The Missouri Farmers Assn. has taken an option to buy all of the buildings and equipment of the Empire Milling Co. and the 330,000-bu. Hannibal grain terminal at Hannibal, F. V. Heikel, Missouri Farmers Assn. president, has announced. The Hannibal companies operate a grain terminal on the Mississippi River and have retail facilities for handling feeds and farm supplies.

The Use of Bins in Feed Plants

By A. R. Hettelsater
President, Jones-Hettelsater Construction Co., Kansas City

In looking back through the years, it is interesting to note that the development of feed processing plants has revolved mostly around the use of bins for various purposes. With the exception of developments in pelleting, there have been few changes in equipment used in a feed mill over the past 25 years, and while in many respects this equipment has been refined and improved essentially, the batch mixers, grinders, continuous mixers, packers, elevators, conveyors, etc. are the same as they were years ago and the main development has come in the increasing use of bins for various purposes throughout the mill.

From the days when ground ingredients were dumped from bags into a mixer, the first development was for grain bins to supply the grinding equipment. The next development was for small bins for ground grains processed in the plant and also for meal and other processed soft stock which then were fed through percentage feeders and to continuous mixers.

In the course of time certain producers of ground ingredients, such as soybean meal and millfeeds, found it to their advantage and the advantage of the feed miller to ship such ingredients in bulk, which brought about the need for larger bins for handling these materials in the feed mill. As a logical development, it became necessary to provide still more bins for such materials received in bulk so as to provide a reserve stock for mixing purposes. It seemed reasonable at that point to design the bins over the mixing system large enough so that the same bins could feed the mixers and at the same time provide a certain amount of reserve stock on hand so that there would not be any rehandling of this material inside of the plant.

More and More Bins

It seems that each development in the industry calls for more and more bins of one type or another. For instance, with the development of pelleting, it has become advisable to provide reasonably large surge bins for mashes which could then go either to the pelleting equipment, for making molasses feed, or for packing. Now we have the trend towards bulk shipments of feed, which in turn would make it advisable to provide bins for finished products for quick loading into trucks or cars.

A modern all-purpose feed mill necessarily developed into one of the most complex operations in the cereal industry when one considers the number of ingredients and the number of different finished products which are involved. Even with this growing complexity, some of the modern mills are actually producing feed with fewer man hours of labor per ton than has ever been done before and also gaining the important advantages of purchasing many of the ingredients in bulk at a substantial saving over prices of the same materials in bags. Necessarily the capital investment required in such a mill is comparatively large, but when

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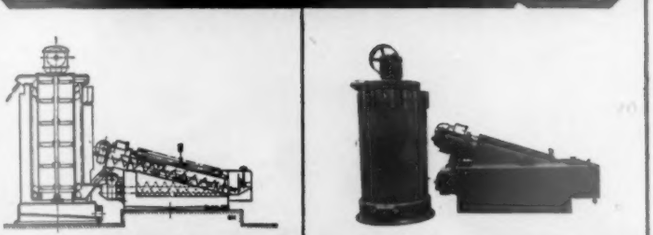

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operating economies are considered, the savings in production costs justify this large investment if a plant is located so that a reasonable production schedule can be maintained.

Kinds of Bins

In the old days a few bins for holding grain for grinding were virtually all that were required, while at the present time it has been found desirable to have the following various kinds of bins in the plant:

1. Grain bins over grinding equipment.
2. Bins over mixing equipment for grains which are ground in the plant.
3. Bins over mixing equipment for soft ingredients which can be received in bulk, such as soybean meal, cottonseed meal, linseed meal, distillers' grains, brewers' grains, millfeeds, etc.
4. Bins for mash from the mixing system to supply pellet mills, molasses mixers, etc.
5. Finished product bins to feed packers.
6. Finished product bins to supply bulk feed to trucks or railroad cars.

As the requirements for a feed mill cover such a wide range depending upon location, capacity and finished products involved, it is impossible, of course, to arbitrarily make recommendations for the number and size of these various classifications of bins.

General Recommendations

In general, however, we think that good design would call for a range somewhat as follows:

1. Enough bins over grinding equipment to accommodate each of the various grains which are being ground and used in the plant. If a separate grain elevator is available, these can be small in capacity as grain can readily be transferred from the grain elevator to these grinding bins. If, however, there is no grain storage available, we feel that these bins should have a capacity of at least two carloads so that the operator can replenish the supply while he still has a substantial amount on hand.
2. There should be enough bins for ground grain processed in the plant to accommodate each kind of grain which is being used but we do not see any need of having bins of large capacity for this work, provided grinding capacity is sufficient to keep up with mixing capacity.
3. Bins over mixing equipment for soft ingredients received in bulk should have a capacity of at least a car and a half unless reserve storage bins are provided with ready means of transferring from reserve stocks to working bins. The number of these working bins, of course, will depend entirely on the particular situation but we consider ten to be a minimum.

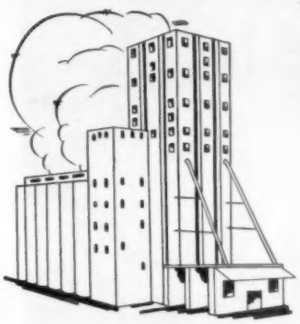
Soft Ingredients

4. The item of storage bins for reserve stocks of soft ingredients is one mostly dependent upon the origin of these supplies. For instance, we recently had occasion to add a substantial amount of storage of this type for a feed mill on the West Coast because their supplies of soybean meal had to come from a long distance and they need to carry a substantial inventory to provide for delays in shipment. At other plants which we have built it was not considered necessary to provide any reserve of this type as supplies were readily available from nearby processing plants.
5. Here again the number of bins required is dependent upon many other factors, but we feel that there should be a sufficient number so that if the mixing formula varies, there will always be an adequate supply ahead of the pellet mills and molasses mixers. For this purpose we do not recommend very large bins as there is too much danger of separation. Where it is advisable to have large bins for this purpose, it is of course possible to so design them by means of baffles or some other method to keep the feed from falling free.
6. These finished product bins over packers, we believe, should only be large enough to take care of a shutdown of the packer due to broken threads and other short delays. It is often desirable, however, to have two bins for each packer so that formulas can be changed without shutting down the packing operation.
7. The particular requirements for supplying bulk feed vary so much in different localities that no fixed recommendation can be made regarding number or size of bins for this purpose. The most desirable, however, would be to have enough capacity in different bins so that the second shift perhaps could provide all of the bulk feed needed for delivery the next day and thereby save one packing crew. There are, how-

(Continued on page 16a)

PAPER SACKS FOR MILLERS
The Chatfield & Woods Sack Co.
CINCINNATI, O.

ROLL GRINDING and CORRUGATING
Also NEW ROLLS for Sale
TWIN CITY MACHINE CO.
Minneapolis, Minn.



WE REPEAT

"You can treat a bin of grain with Weevil-Cide as cheaply as you can with the lowest-priced fumigant available".

The best way to demonstrate this is to figure costs using the lowest current prices and the dosages recommended by the manufacturers.

If all fumigants were equally effective, then cost-per-gallon would determine the cheapest. **But this isn't the case.** The fact that all fumigants are **not** equally effective is recognized by both the fumigant manufacturers and the Federal government. The dosages shown on the labels must be approved by a department of the government.

The dosages used in these calculations are lowest on the labels of 80% carbon tetrachloride — 20% carbon bisulphide mixtures and for the same mixture with 5% of ethylene dibromide added. These mixtures and Weevil-Cide, a fireproofed carbon tetrachloride—carbon bisulphide mixture, account for the bulk of fumigant usage. They are also the cheapest.

For average-sized (10,000 to 20,000 bushels) concrete bins the dosage given for the first two types is 2 gallons per thousand bushels **plus twice this amount** for both the **first and last drafts.** This averages 2.2 gallons per thousand bushels. The dosage for the same size bin is 1½ gallons for Weevil-Cide —no hidden dosage necessary.

All freight is figured from Kansas City to Chicago. The prices are those in effect Febuary 15, 1955. The less truckload price for Weevil-Cide is our highest priced quantity, less than 500 gallons.

LESS THAN TRUCKLOAD IN 5-GAL. DRUMS

	80-20	80-20 PLUS ETHYLENE DIBROMIDE	WEEVIL-CIDE
Price Per Gallon	$1.84	$2.10	$2.10
Freight	.21	.21	.21
	$2.05	$2.31	$2.31
Dosage	2.2	2.2	1.5
	410	462	1155
	410	462	231
Cost Per 1000 Bu.	$4.510	$5.082	$3.465

CARLOAD IN 5-GALLON DRUMS

	80-20	80-20 PLUS ETHYLENE DIBROMIDE	WEEVIL-CIDE
Price Per Gallon	$1.51	$1.81	$1.90
Freight	Delivered	Delivered	.10
	$1.51	$1.81	$2.00
Dosage	2.2	2.2	1.5
	302	362	1000
	302	362	200
Cost Per 1000 Bu.	$3.322	$3.982	$3.000

LESS THAN TRUCKLOAD IN 53-GAL. DRUMS

	80-20	80-20 PLUS ETHYLENE DIBROMIDE	WEEVIL-CIDE
Price Per Gallon	$1.59	$1.85	$1.95
Freight	.21	.21	.21
	$1.80	$2.06	$2.16
Dosage	2.2	2.2	1.5
	360	412	1080
	360	412	216
Cost Per 1000 Bu.	$3.96	$4.532	$3.24

CARLOAD IN 53-GALLON DRUMS

	80-20	80-20 PLUS ETHYLENE DIBROMIDE	WEEVIL-CIDE
Price Per Gallon	$1.26	$1.56	$1.75
Freight	Delivered	Delivered	.10
	$1.26	$1.56	$1.85
Dosage	2.2	2.2	1.5
	252	312	925
	252	312	185
Cost Per 1000 Bu.	$2.772	$3.432	$2.775

These calculations—based on actual dosages as stated on the labels and on the lowest competitive prices available —**show necessary difference of 60c in delivered cost to match the low cost of Weevil-Cide.** And at that difference, or at any difference, they can't match the record of Weevil-Cide for consistent results.

Weevil-Cide The DEPENDABLE GRAIN FUMIGANT

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For Information, Write: THE WEEVIL-CIDE COMPANY
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Worth Looking Into

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New Literature

This reader service department announces the development of new and improved products, new services and new literature offered by manufacturers and suppliers. Claims made in this department are those of the firm concerned. Use the accompanying coupon to obtain the desired information.

No. 5036—Vacuum Cleaner

The Breuer Electric Mfg. Co. has announced a new series 80 heavy duty industrial and commercial type vacuum cleaner. This machine features a motor or power unit that can be removed by ¼ turn from the top of the tank cover. This motor unit can then be converted into a portable electric blower, a pack carried vacuum cleaner, an insecticide sprayer, or an air sweeper for removal of paper and debris. A large size tank cover plate is available to fit a 55 gal. drum, therefore converting the capacity of the cleaner to 55 gal. with the addition of a large size filter bag. Wet or dry pickup is available. Three models are available in ¾, 1 and 1½ h.p. sizes. Complete literature and information is available by checking No. 5036 on the coupon and dropping it in the mail.

No. 5103—Valve

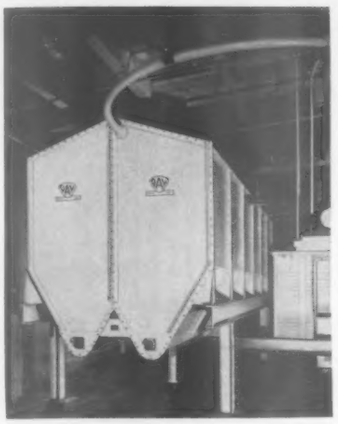
Pulva Corp. has announced new features in its product, called by the trade name, Pulvalve, a rotary air lock or valve. It is available in three sizes, 4 in., 6 in. and 8 in. and has applications such as in continuously discharging cyclones, dust collectors, hoppers, continuous dryers, conveyor feed or discharge, pulverizer discharge and others. It uses an eight-vaned rotor which provides for at least two vanes to be in contact with the valve body at all times. Standard wiper blades are made of a cloth laminated plastic but other materials such as brass, copper, Teflon, nylon, etc., can be provided if specified. To secure more complete information check No. 5103 on the coupon and drop it in the mail.

No. 6177—Safety Slogan Gloves

To encourage the promotion of safety measures, the Fairfield Glove Co. is manufacturing industrial work gloves with safety slogans on them. Other slogans are also available which include maintenance, housekeeping, economy of materials, workmanship and mysterious disappearance. Safety slogans are printed directly on the gloves, according to customer specifications. Some slogans already in use are: Don't Be Sorry—Be Safe! Be Careful—Live Longer, Are Your Goggles On? Protection Pays, Ouch! It's Hot, and Think First. To secure more details check No. 6177 on the coupon and mail it to this newspaper.

No. 3650—Horizontal Bins

The Day company's horizontal storage bin shown in the Excelsior Baking Co. photograph handles a full truck load (400 cwt.) of flour. It is pneumatically loaded and mechanically emptied and savings of 15¢ to 25¢



per cwt. are claimed. With this bin, materials can be conveyed and discharged, at the point of use, automatically. The company manufactures both vertical and horizontal type bulk storage bins. Secure more detailed information by checking No. 3650 on the coupon and dropping it in the mail.

No. 5090—Lift Truck Operation

The sixth printing of the booklet, "How to Operate a Lift Truck," has been completed by the Hyster Co. and the 24-page publication is now available again free to lift truck operators and users. The two-color cartoon technique used in the booklet is designed for easy reading. Information about the operation of a lift truck, preventive maintenance, safety and basic materials handling are included. Secure the booklet by checking No. 5090 on the coupon and dropping it in the mail.

No. 5058—Tractor Shovel

The Frank G. Hough Co. announces production of an improved Payloader tractor-shovel with bucket capacity of 1 cu. yd. payload and ¾ cu. yd. struck load. Designated as the model HFC, it is a rear-wheel drive model and features a combination of special new transmission, plus torque-converter drive. The torque-converter is of the self-cooled, 3-element type which automatically multiplies torque output of the engine in direct proportion to the load requirements. The transmission is of full-reversing type, giving four speeds forward and four reverse up to 28 mph. To secure more information check No. 5058 on the coupon and drop it in the mail.

No. 5026—Freight Car Sealing

A new method of sealing or coopering railroad freight cars has been announced by A. J. Gerrard & Co. The company's coopering method is in the form of a kit which ultilizes Fiberglas-reinforced kraft paper, oak posts and steel strapping. Tests have been made on 5,000 carloadings during the past two years, the company states. The kit consists of two sheets of paper, each large enough to barricade one door to the proper height. Vertical oak posts in the center of each doorway are connected with steel strapping through the interior width of the car. The unit is installed by nailing the edges of the paper, which are wrapped around a plywood strip, to the inside of each door. To secure more complete details about this method and kit check No. 5026 on the coupon and drop it in the mail.

No. 5083—Magnetic Pulley

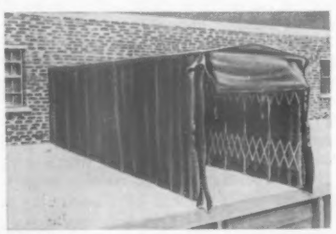
The Homer Manufacturing Co., Inc., manufacturer of the Homer Hercules permanent magnetic pulley, describes this product's applications and features in a new illustrated 8-page bulletin, PY-260. These pulleys automatically remove tramp iron from feeds, chemicals and other materials, and separate ferrous from non-ferrous materials, the bulletin states. The bulletin includes diagrams, performance data, specifications and a guide for selecting proper size. To secure the bulletin check No. 5083 on the coupon and drop it in the mail

No. 5084—Level Indicator

A descriptive folder about a level indicator called Bin-Vue has been prepared by its manufacturer, Convair, and is available without charge. The folder contains construction diagrams, photographs, descriptions and price information about four models. The four are the standard, heavy duty, explosion proof and high temperature models. The indicator is suitable for powdered, granular, lumpy and wet materials and slurries, the folder states. To obtain the folder check No. 5084 on the coupon and drop it in the mail.

No. 3636—Loading Dock Shelter

X-Tra-Span is the trade name of a new loading dock shelter, just introduced by Atlas Industries. This model was designed for use on extra-deep loading docks, or it can be used



to connect adjoining plants. It rolls on special wheels and when not in use, folds compactly back around the shipping room door. The model

Send me information on the items marked:

- ☐ No. 3636—Loading Dock Shelter
- ☐ No. 3650—Horizontal Bins
- ☐ No. 5026—Freight Car Sealing
- ☐ No. 5036—Vacuum Cleaner
- ☐ No. 5058—Tractor Shovel
- ☐ No. 5083—Magnetic Pulley
- ☐ No. 5084—Level Indicator
- ☐ No. 5090—Lift Truck Operation
- ☐ No. 5094—Bagging scale
- ☐ No. 5099—Bagging Machine
- ☐ No. 5103—Valve
- ☐ No. 6177—Safety Slogan Gloves

Others (list numbers) .....

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is completely portable and can be moved from door to door. X-Tra-Spans can also be custom-built to any length. To secure more complete details check No. 3636 on the coupon and mail it.

No. 5094—Bagging Scale

The Richardson Scale Co. offers a product data sheet on its improved GGG-38 bagging scale. This mechanically-operated weighing unit has been equipped with a synchronized belt feeder and a pneumatic inlet-gate assist, both of which enable it to operate faster, handle lumpy materials and weigh down to 25 lb., it is claimed. Besides a detailed description of the scale, the data sheet includes lists of seven specifications and five features. Included also are a photograph of the unit and a dimensioned engineering drawing. To secure this data sheet check No. 5094 on the coupon and mail it to this publication.

No. 5099—Bagging Machine

Union Bag & Paper Corp., sales agent for Inglett & Corley's new I & C bagger (model UB-101) has announced that the machine is ready for distribution. The machine works in conjunction with a moving conveyor and sewing head. The weighing and filling cycle is automatic. A starter button automatically permits delivery of the pre-weighed material through the machine's bag chute in an endless series. The filled weight drops each of the open mouth multiwall bags onto a moving conveyor belt which leads them through the sewing head. A dial type scale is double-faced so that both the closing and filling operators can see it. This model will weigh units from 25 to 200 lb. A system of switches within reach of the bagging operator enables him to change weight units immediately by operating the switch covering the desired unit. To secure more complete details check No. 5099 on the coupon and drop it in the mail.

—BREAD IS THE STAFF OF LIFE—

MACHINERY REPLACEMENT

Every industrial plant should have a planned program of replacement of machinery, engineers advise. In addition to knowing the costs of new machinery, a plant should know what it costs not to replace machinery. A number of factors must be considered when machinery is about to be replaced. Among these are the life expectancy and cost of existing machinery as compared to the cost and increased productivity of proposed equipment.

CHECKERBOARD ELEVATOR CO.
MILLING WHEAT • COARSE GRAINS • MILLFEED
Hard and Soft Winter Wheat
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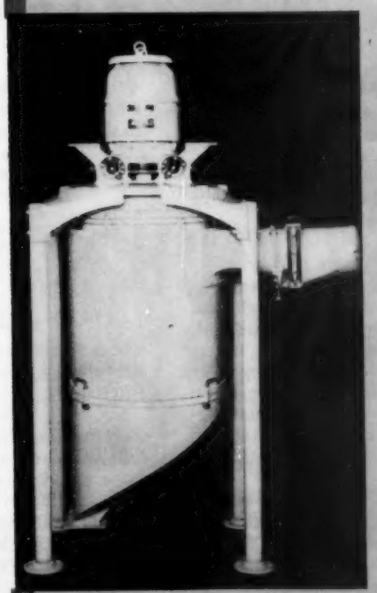
PROVEN PROTECTION against hidden infestation
"ENTOLETER" SCOURER-ASPIRATOR

- the only continuous mechanical system of infestation control GUARANTEED to reduce the fragment count on finished flour without increasing the loss to screenings.
- the most modern equipment available for preparing wheat for milling operations.



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- is efficient...compact and especially designed to insure low maintenance and long service!
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Name..... Title.....
Company..... Street.....
City..... Zone..... State.....
TYPE OF WHEAT PROCESSED.....
Mill Capacity (bushels per hr.).....
Present loss to screenings.....%
☐ I am sending a sample of our product (5-25 lbs.) to your laboratory for free processing on an "ENTOLETER" SCOURER-ASPIRATOR.

The trademark "ENTOLETER" is your guarantee of complete satisfaction

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EXTRA! Big News!

for everyone with a Pest Problem!

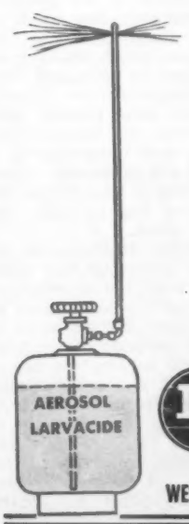
Now LARVACIDE in aerosol form is being applied in mill and storage space with instant gasification!

With AEROSOL Larvacide, it takes less time to fumigate, less time to aerate — and you get the wellknown LARVACIDE kill: insects, egglife, larvae — rodents too, without carcass nuisance. Rats are driven out of retreats, die on the open floor where they're easily swept up.

AEROSOL Larvacide is released under pressure by simply opening a valve. The gas travels up to 50 feet in five or six seconds. Penetrates mill machinery, cracks and sacked goods. Gets into those remote retreats where pests may find refuge from fumigants less potent.

Look into AEROSOL Larvacide today. See how much quicker and how much more easily it does the job you want.

Liquid LARVACIDE is still available, in cylinders of 50, 100, 180 and 250 lbs. net, and those handy 1 lb. dispenser bottles, each in sealed can.



Write for YOUR GUIDE to Effective and Safer Mill Fumigation

Larvacide Products, Inc.
117 Liberty Street, New York 6, N. Y.
WEST COAST OFFICE—1515 Third Street, San Francisco 7, Calif.

USE OF BINS

(Continued from page 13a)

ever, many situations where this is not practical and the facilities would have to be tailored to meet each individual case.

To point up the development through the years, our company recently completed a mill with 83 bins for the various purposes outlined above. We do not mean to imply that this many bins are essential for a good operation or that in some cases more might be required, but just point it out as a result of this development.

Bin Types

In deciding upon the type of bins to be used in a feed mill, the choice generally becomes one between steel or reinforced concrete bins. Feed milling being an essentially hazardous industry from a fire and explosion standpoint, the use of wood construction should not be considered for any permanent installation. In choosing between steel and concrete bins, the overall design of the plant must be considered as well as the purpose to which bins are to be put and the size of bins.

Generally speaking, rectangular steel bins tend to become very expensive, and round steel bins have a disadvantage of using almost double the floor area which would be required for concrete bins. This is not a handicap in certain operations such as packing bins and others where no large capacity is wanted, but where bins to hold one or two cars of material are desired, it becomes a serious drawback.

There are, of course, many places where the feed miller must take advantage of an existing building where steel bins are the only practical thing to build, but we feel that where a new mixing unit or an entire new feed mill is involved, concrete construction is by far the most economical and satisfactory type of construction.

Our company has more or less arbitrarily considered that where bin capacity of less than 10 tons is required, steel may very well be the proper answer, but from there up to 100 tons, we recommend rectangular concrete bins. For a reserve storage where it may be desirable to design bins holding up to 500 tons, or even more we recommend round concrete bins.

It goes without saying that no matter what material is used, the proper design of the bin and hopper under the bin is absolutely essential to the successful operation of the plant. In rectangular bins we always like to have our hoppers in the corners, giving us two straight sides with a slope on the hoppers of at least 60°. We prefer to use steel bin bottoms as they can be made more accurately than it is possible to pour concrete bottoms. We also like to see the bin walls for soft stock given a smooth finish so that there is no obstruction of flow of materials to the hopper. On certain materials, such as bran and ground oats, we have also found it to be advantageous to provide compressed air jets as near the top of the hopper as possible to break up any bridging action.

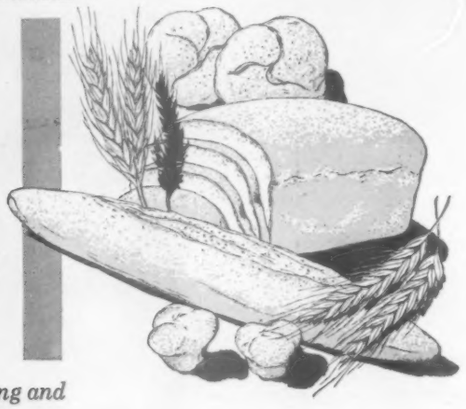
In designing large tanks for storing reserve supplies of ground ingredients, we generally design these with several openings in the bottom with screw conveyor feeders under each opening and the hog backs between openings having a slope of at least 60°. We have put in several installations like this dating back as far as 25 years, and in general they have worked satisfactorily. It is obvious, however, that in storing soft ingredients in bins of this size, careful attention must be given to the moisture content of the materials. We have also found it advisable with bran to keep turning it frequently as there is a tendency for it to pack if left in a bin very long, and it can then become a real problem.

The present trend towards selling finished feed in bulk brings about new problems. We have built some plants where bins for this purpose were incorporated in the feed mill and which have worked out very well. In the large majority of cases, however, these arrangements for bulk loading are being added to existing plants where it is not practical to get the necessary bins inside of the plant. In these cases the best answer we have found yet is overhead steel bins so arranged that trucks can drive under them. This, of course, involves some method, such as a truck scale, for weighing the feed put into each compartment of the truck and also preferably should provide some way of transferring left over amounts of feed in these bins back into the plant.

There are other developments going on in the design of feed mills, all of which have the objective of producing a more uniform feed at lower costs. These include more or less automatic methods of weighing materials to the mixers, the use of bindicators which can automatically control the transfer of materials to replenish working bins, the use of remote controls for turnheads and conveyor discharges, and other items of this nature, but the effectiveness of thees developments all depend upon having the proper bins.

Advertisement

FLOUR FOR MAN'S BREAD*



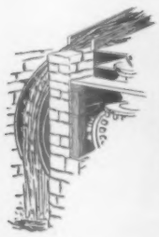
A Brief History of Milling and Baking by SCIENCE WRITER

CHAPTER VI. *Waterwheels and Millstones.*

THE STORY SO FAR

In preceding chapters we learned how men changed from hunting animals to cultivating grains for their food; how grain culture and milling improved as new grains and tools developed; how milling and baking left the home and became business; how the bread wheats and the arts of milling and baking spread across the world.

NEW SOURCE OF POWER



Larger, more efficient millstones were developed as it was discovered that they could be turned by a source of power which exerted much more force than that supplied by men or animals. This new source was gravity in the form of swiftly-running water which was transmitted to grinding stones through waterwheels.

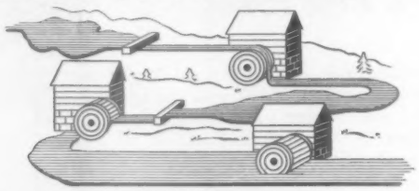
MANY TYPES OF WATERWHEELS

In Roman times the architect Vitruvius described a waterwheel which powered a mill to grind grain.

Over the centuries waterwheels were improved. Gearing between the waterwheel and the millstones was introduced. Waterfalls and rapids were used as mill sites. In fact, cities often grew up around these places as Minneapolis around the Falls of St. Anthony. Mill dams were constructed to harness the power of the tides. Experimentation with the dressing of millstones brought about better milling. As the principles of hydraulics came to be understood, the direct drive mill gave way to more efficient types. Auxiliary drives were developed for hoisting the grain to the hopper and later for powering the sieves which bolted the meal.

THE MOST EFFICIENT WATERWHEEL

For almost two thousand years there was argument among millers about the most efficient type of waterwheel: overshot, breast or undershot. In an overshot wheel the water meets the wheel's paddles at the wheel's top. In a breast wheel it meets the paddles midway in the wheel. And in an undershot wheel the water meets the paddles at the bottom. As time passed, the millwrights found that the best arrangement of the waterwheel varied with conditions of the stream. Then early in the 19th Century came the development of the turbine



which was found to be 87% efficient. The water rotated the wheel by impulse on entering and by reaction on leaving.

TODAY'S NUTRITION

Turbines evolved from waterwheels; cities grew from mill sites; and small, local millers and bakers expanded into nationwide organizations. As the business of milling grew so did the knowledge of wheat's nutritive values. Millers and bakers found that they could give the public the fine white flour and bread which it demanded and still supply important vitamins and minerals which are unavoidably lost during milling. They do this through enrichment which is the simple process of adding vitamins B_1, B_2, niacin plus iron, and sometimes calcium to the flour as it is being milled. Result: better nutrition for countless millions of people.

This is one of a series of articles which is being published in professional nutrition and dietetic journals, and which will be widely distributed for educational purposes. Reprints of this and all other chapters are available without charge. Write to the Vitamin Division, Hoffmann-La Roche Inc., Nutley 10, New Jersey. In Canada: Hoffmann-La Roche Ltd., 286 St. Paul Street, West; Montreal, Quebec.

*This is the title of a definitive history of milling by John Storck and Walter Dorwin Teague, published by the University of Minnesota Press at Minneapolis and copyrighted by the University of Minnesota. It is used with permission as a source of material for this series of advertisements.

The next chapter titled: "The Winds and The Mills" will be published soon.

Enriched with vitamins and iron for better nutrition

TEMPERATURE MEASUREMENTS

(Continued from page 1a)

d. Temperature of rolls—The rolls can be hotter or cooler than the product. They can therefore change the temperature in the grinding gap in a positive or negative direction. The interrelationship between rolls and product is two-sided; the product also exerts a cooling effect on closely set rolls. In a 1st middling stand, a gap temperature of 13° C. was recorded in an ambient of 7° C. Immediately after disengagement of the set of rolls, the thermocouple registered a roll temperature of 23° C. because the flow of the product which had a cooling effect on the rolls had stopped. The product measured 3.5 and 11.8° C. before and after passing through the rolls.

e. Corrugations—Higher heat readings for dull to dull corrugation confirmed previous experience. (See Table III.)

f. Elasticity and hardness of product — Greater hardness, of course, causes increased heating. The greater temperature gain at the tail of the flow sheet may be caused not only by closer roll settings, but also by the tougher materials handled at this stage of the mill.

Table V—Cooling of Product and Evaporation

Tm-Tn °C.	Evaporation Calculated	Evaporation recorded in tests Average	Evaporation recorded in tests Range
1	0.17	0.12	0 -0.25
2	0.13	0.19	0 -0.55
3	0.20	0.18	0.07-0.30
4	0.27	0.30	0.05-0.45
5	0.33	0.27	0.08-0.66
6	0.40	0.41	0.26-0.57
8	0.53	0.45	0.45

Table VI—Effect of Air Humidity on Evaporation

Relative humidity of air, %	Moisture content, % Feed to 1st middlings	Feed to last reduction	Difference	Temperature in mill, °C.
36	16.95	12.95	4.00	7.0
58	16.81	12.97	3.84	22.0
60	16.53	12.10	4.43	26.0
68	16.18	11.17	5.01	19.0

Course of Temperatures Within the Milling Diagram

Table IV shows that grinding gap and product temperatures rise gradually from the head to the tail of the mill, with the exception of the 1st break, which runs hotter than the 2nd break. This could have two causes: higher relative loading of the first break rolls, and more severe cutting and destruction of the cellular structure of the grain at this point.

The range of measured temperatures shows a variation of about 100% for the breaks. Variations reach 500% and more in the reductions. Wide differences occur from mill to mill, while temperatures recorded in the same plant on different days remain rather consistent.

Evaporation

Heat loss by evaporation between the grinding gap and when the product leaves the rolls (Tm-Tn) was calculated. Table V shows the theoretical values and test data. While some of the recorded average test values indicate agreement with calculated figures, the wide range of test data casts doubts on the significance of the comparison. The principal sources of inaccuracies were difficulties in accurately determining the small differences of moisture in the test. The theoretical calculation must be considered approximate at best. Specific heat values had to be assumed, and all forms of heat transfer other than evaporation were neglected.

Generally, cooling action increases with rising previous heating of the product. The influence of gap temperature on evaporation is small. The data of Table VI do not demonstrate a clear-cut relationship between evaporation and relative humidity or temperature of the mill air. Therefore, if a small evaporation loss is desired, this can generally only be obtained by cool milling.

Table VII—Effect of Water Cooling

	Gap °C.	Product Before rolls °C.	Product After rolls °C.	Difference °C.
2nd Sizings—				
Water cooled	17.8	13.4	17.7	4.3
2½ hours after cooling stopped	19.6	13.5	18.3	4.8
Difference	1.8	0.1	0.6	0.5
10th Reduction—				
Water cooled	39.7	24.9	36.0	11.1
30 minutes after cooling stopped	42.0	24.9	38.5	13.6
30 minutes after cooling was started again	40.0	25.0	38.5	13.5

Table VIII—Cooling by Purifiers

Test—	A	B	C	D	E
Grain, °C.	13.5	18.0	6.8	25.6	17.5
Product, °C.:					
1st Break, output	17.1	20.5	9.5	28.5	21.8
2nd Break, feed	16.8	19.1	7.8	26.8	20.0
1st Middlings, feed	12.5	14.2	3.5	24.0	17.0

Water cooling is one of the methods employed to reduce the temperature of rolls. The tests indicate that this method accomplishes a reduction in temperature differential. Experiments also show that some time is required after the start of cooling before a balanced condition is reached between the temperatures of the rolls, gaps and product. Water cooling also reduces the evaporation loss due to lower milling temperatures. (See Table VII.)

Middlings purifiers have proved themselves very effective in cooling products between passages through rolls. The products entering sets of

Analysis of Accidents in the Grain Milling Industry

The above pie chart shows an analysis of accidents in the grain milling industry. The chart was prepared by the Lumbermens Mutual Casualty Co., Chicago. As may be seen here, handling of objects accounts for 29% of the accidents in the industry, and included in this are lifting and pushing, which account for 24% of all accidents. Other major accident causes are falls, 19%; struck by objects, 23%, and machinery, 13%.

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reduction rolls which have been swept by air in purifiers show low original temperatures on all tests. (See Table VIII.)

Pneumatic conveying results in a cooling effect similar to that of purifiers. Two of the mills checked used pneumatic systems but no direct comparison could be made because of basic differences between the mills.

The maximum temperature read at a gap was 51.5° C. (125° F.); the average was about 30° C. (86° F.). These figures are much lower than what had previously been suspected. The gap data are confirmed by temperatures recorded below the grinding gap. Products lost an average of 3.1° C. after grinding. The chances that they could lose much more heat in this short, not overly well aspirated distance, are unlikely. Power consumption data also speak against the likelihood of higher temperatures at the grinding gap.

It is possible that local temperatures at the surface of the ground particles exceed the recorded values. The exact temperatures of such hot spots cannot be experimentally determined; there is a possibility that they could be elevated enough to damage very small areas of gluten and starch. The percentage of the product so affected would be exceedingly small, and this could have no noticeable effect on the overall characteristics of the product.

In addition, the highest grinding gap temperatures were measured near the tail of the mill, where little flour is produced. The more vital front reductions run much cooler on account of the cooling effect of the purifiers.

A milling machine which applies most of the introduced energy for grinding is more efficient than one which transforms most energy into heat. Cool milling is therefore an indication of efficient grinding, and routine recording of temperatures in the plant to assure continuous efficiency of milling operations is recommended.

Letters to the Editor

To the Editor:

Twenty-five Lives Lost in Hotel Fire . . . Fire of Unknown Origin Sweeps Through Hotel Building . . . Property Damage Exceeds One Quarter Million Dollars.

These were some of the news headlines in every Chicago paper recently following a hotel fire. Neither the newspaper stories nor the pictures could tell the full facts. Perhaps no one will ever know the origin of this fire or be sure of the exact cause.

This is another instance in our society which, when written about by experienced reporters, will undoubtedly fall into the classification of "human interest" stories. The firemen and others who worked frantically in the midst of this blaze, and perhaps the little man on the city's fire prevention squad, surely feel that the real and beneficial human interest was too late with too little. Meanwhile, there were expected to be investigations and conferences. Fire prevention regulations, building and safety codes, licenses and occupancy permits could be expected to be combed and discussed. Inspection crews would work long hours to uncover likely causes of fire and violations of safety regulations.

Time, however, cools the hot embers, and our own human memory generally forgets that it can happen again.

What place does a reminder of this sort have here? To me, the answer is simply this: Fire can strike anywhere. It can strike at any time and with very little forewarning. The next tragedy may be in a department store, a theater—or a mill, a warehouse, a grain elevator. The loss might be in lives, or it might be in hard cash. It might mean disaster to one or to many.

Right now, before anyone dares to think that "it can't happen here," is the time to put "human interest" into real and beneficial practice. We should do it now, with planned forethought and determination.

Every mill and elevator operator should comb every department, area and location for likely fire sources. Correct the fault now. Insist that the program be continuing. The cost in dollars will be negligible, and the display of human interest and welfare might be contagious.

Tom A. Adler, Engineer,
Mill Mutual Fire Prevention Bureau, Chicago.

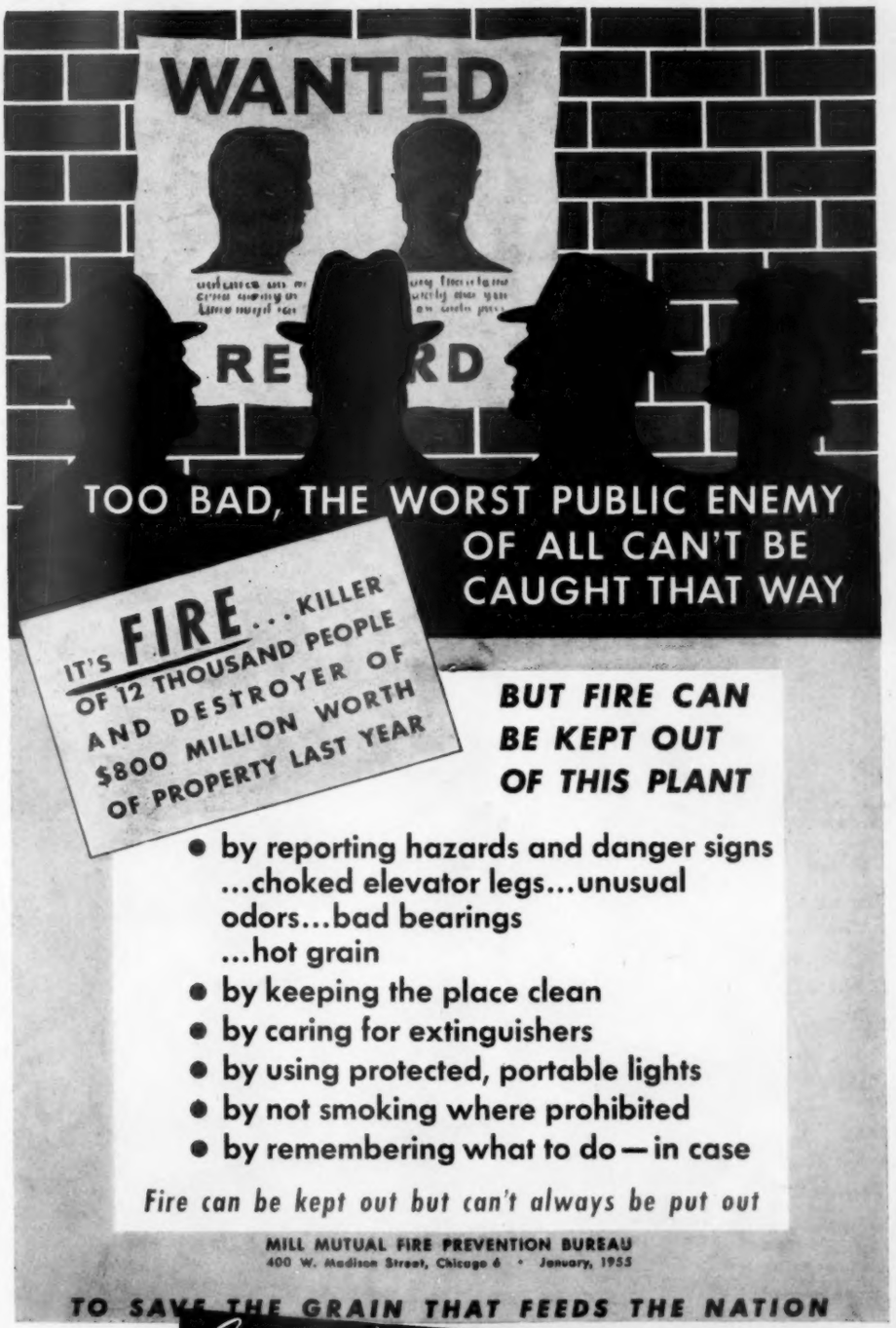
——BREAD IS THE STAFF OF LIFE——

Western Maintenance, Engineering Show Set

LOS ANGELES — The second Western Plant Maintenance and Engineering Show will be held July 12-14 at the Pan Pacific Auditorium in Los Angeles.

The show will bring together the latest developments in machinery, tools and materials needed to equip and maintain the modern factory or plant. Producing the show will be Clapp & Poliak, Inc., New York, exposition management firm which also produces the national show.

In connection with the show will be a maintenance and engineering conference.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